End of Result Set

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TITLE: System and method for providing group communication services in an existing communication system

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Brief Summary Text (6):
Another example of a point-to-multipoint communication system is a wireless push-to-talk system. Such a system allows a group of individuals, each having a wireless telephone, to communicate with other members of the group. Typically, a push-to-talk system relies on a single frequency, or dedicated channel, over which communications are received by the wireless telephones. In most systems, only one member may transmit information to the other members at a time. However, all members can listen to the dedicated broadcast channel to receive communications from the single member who is transmitting. Members desiring to transmit to other members of the system typically send an access request by depressing a push-to-talk button on a respective communication device which allows sole access to the dedicated transmission channel.

Brief Summary Text (8):
In a typical push-to-talk system, a dedicated channel, sometimes referred to as a broadcast channel, is used to transmit communications from one member to multiple other members of the net simultaneously. Generally, only one member may transmit voice information to the other member users at any given time. If another member attempts to transmit over the broadcast channel while another member is transmitting, interference between the two competing communications will occur, resulting in non-intelligible communications being received by the other net members.

Brief Summary Text (13):
Point-to-multipoint communications are enabled in the present invention by converting real-time audio, real-time visual, and data, collectively referred to herein as media) into data packets in a communication device (CD). The data packets are produced in accordance with standard data protocols, for instance, the well-known TCP/IP Internet protocol. The media is transmitted using an air interface, or by other means, depending on what type of communication device is used, to a data network, typically the Internet.

Detailed Description Text (2):
The present invention is a system and method for providing group communication services in an existing communication system. The present invention uses a communication device (CD) capable of generating data packets suitable for transmission over a data network such as the Internet. The data packets are transmitted to a data network, which are then provided to a communications manager (CM) connected to the data network. The CM processes data packets from a first CD and distributes the data packets in real-time to at least one other CD who is a member of the same predefined net as the first CD. CM acts as a configurable switch able to route communications from any net member to other net members defined by the net.

Detailed Description Text (3):
Although the teachings of the present invention are described with respect to a wireless CDMA communication system, it should be understood that the present invention can be used with any wireless communication system including GSM systems, AMPS systems, TDMA systems, satellite communication systems, as well as other communications systems. In addition, the present invention is not limited to wireless communication systems. It can be used with wireline telephones, paging devices, portable or desktop computers, digital cameras, video cameras, etc. Furthermore, it should be understood that the present invention is applicable to both real-time data, such as audio and video data (including voice data) and time-independent data, such as computer files, email, and so on.

Detailed Description Text (8):
The present invention is illustrated in functional block diagram format in FIG. 2. Shown is group communication system 200, otherwise known as a push-to-talk system, a net broadcast system, a dispatch system, or a point-to-multipoint communication system. A defining characteristic of such a communication system is that, generally, only one user may transmit information to other users at any given time. In group communication system 200, a group of communication device users, individually known as net members, communicate with one another using a communication device assigned to each net member.

Detailed Description Text (11):
In the group communication system of FIG. 2, an exclusive transmission privilege is defined which generally allows only a single user to transmit information to other net members at any given time. The transmission privilege is granted or denied to requesting net members, depending on whether or not the transmission privilege is currently assigned to another net member when the request is received. The process of granting and denying transmission requests is known as arbitration. Other arbitration schemes evaluate factors such as priority levels assigned to each CD in determining whether a requesting net member is granted the transmission privilege.

Detailed Description Text (12):
In order to participate in group communications CDs 202, 204, 206, 208 and 210 are each equipped with a means for requesting the transmission privilege from a CM (CM) 218, as explained in greater detail below. CM 218 manages the real-time and administrative operation of nets, including PTT request arbitration, maintenance, and distribution of net membership and registration lists, call set-up and tear-down of necessary system and network resources, as well as overall control of net status.

Detailed Description Text (15):
SM 228 is an optional component of the system which performs key management (i.e., distribution of encryption keys to net members), user authentication, and related tasks to support secure nets. A single group communication system may interact with one or more SMs. SM 228 is generally not involved in the real-time control of a net, including net activation or PTT arbitration. SM 228 may have administration capabilities compatible with a CM 218 interface to automate administration functions. SM 218 may also be capable of acting as a data endpoint for the purpose of participating in a net, to broadcast net keys, or simply monitor net traffic.

Detailed Description Text (24):
At the application level, the present invention operates over three Internet-based protocols as shown in FIG. 3. Of course, other protocols could be used in the alternative. Communications between CM 218, and CDs 202, 208, and 210 occurs within these protocols. CDs find, join, leave, and learn about various nets using the Session Initiation Protocol (SIP), which is a well-known signaling protocol used in the telecommunications industry. Audio, including voice, video, or data (collectively referred to herein as media), is distributed separately via a third encapsulation. In the example of FIG. 3, CD 202 currently "has the floor", i.e., the transmission privilege, or permission to transmit media to the net. A "floor-control" request is request for the transmission privilege. While CD 202 holds the transmission privilege, the remaining net members, shown on the right, are designated as listeners and correspondingly do not have permission to transmit media to the net. Generally, any CD can send media-signaling or SIP signaling traffic at

any time, regardless of whether it holds the transmission privilege.

Detailed Description Text (26):
In one embodiment, CDs 202, 204, and 206 each provides a data packet connection to CM 218 in accordance with IS-707.5 IP packet data service option. Changes to this interface may be made to optimize group communication performance. No changes to the infrastructure side of this interface are desired, except an implicit requirement for RTP/UDP/IP Header Compression in base stations in order to support media broadcasting using RTP (Real Time Protocol).

Detailed Description Text (28):
CM 218 communicates with CDs participating in group communications via transport and group communication application layer protocols. These communications include application signaling (PTT transmission privilege requests, net registration, etc.) as well as the real-time voice media packet streams distributed by CM 218. All real-time media are distributed via dynamic RTP/UDP/IP interfaces on CM 218 and CDs. If CRTP header compression is unavailable, real-time media is encapsulated directly within UDP/IP packets, or datagrams. All real-time signaling occurs via dynamic UDP/IP interfaces on CM 218 and the CDs. Other signaling may take place via a predefined data protocol interface, such as TCP/IP, between CM 218 and the CDs using the well-known Session Initiation Protocol (SIP), an application-level call signaling protocol designed to support Internet telephony.

Detailed Description Text (30):
CM 218 provides an administration interface which is an application level protocol that provides administrative access of a CM user, net, and administration database and associated parameters using Hyper-Text Markup Language (HTML) semantics. In one embodiment, the interface operates over TCP/IP. A second network interface supporting administrative functions may also exist. This second administrative interface supports the bulk of real-time transfers of administrative information, including membership lists and network status reports, to Java or similar client administrative applications.

Detailed Description Text (64):
At any given time, no more than one net in a CD's group-list may be selected. A default net may be initially selected or the user may select a net from the group-list.

Detailed Description Text (65):
CM 218's SIP user-agent server's response to an INVITE request to join a net includes, as embedded content, the net's media and real-time media signaling destination addresses, as well as other net parameters (such as media payload format descriptors). Once confirmed, CD 202 briefly displays feedback to the user, indicates whether the user has listen-only privileges, and enables group service functions. If CM 218 determines that CD 202 is not a member of the selected net, or an error or other exceptional condition occurs, CM 218 responds with a corresponding error response. When such a registration is rejected, CD 202 briefly displays a corresponding error message and group service functions remain idle.

Detailed Description Text (68):
Upon power-on, a CD enters the idle state 500, which enables at least one service option, such as the voice service option, although CD 202 could alternatively operate in any desired service option. After joining a net, a CD initializes and opens its real time protocol (RTP) media traffic channel and a separate group communication media signaling channel to the CM 218 destination addresses provided in a successful invitation response. Once these channels have been initialized, group-services are activated on a CD, and it enters the group-service quiet state 502 with the ability to receive media traffic from the net and request permission to send voice traffic.

Detailed Description Text (69):
With group services active, a CD monitors its media traffic and signaling channels to CM 218. Voice data received on the media channel are decoded and presented using speaker 430 or earpiece 440, according to the current user configuration. A CD may display the identity of the current speaker, as identified via real-time media

signaling. If the identity of the current speaker is unavailable, a CD may display the current selected net name as listed in the group-list. A CD may also tabulate media traffic statistics (for example, total time spent talking, listening, and monitoring, estimated media traffic receipt packet loss) and make these available to the user as a diagnostic via a menu option. While receiving traffic from the net, a CD transitions to group-services listen state 504, returning to quiet state 502 when voice traffic stops.

Detailed Description Text (70):
At any time, the user may request permission to speak to the net by depressing the PIT button and causing a CD to signal CM 218 (specifically, the net's MCU) with a floor-control request. CM 218 responds by either granting or denying the request. If a CD has listen-only privileges (that is, a CD has a priority-level of zero within the selected net), the request will be denied. If denied, a CD may alert the user with an error tone, display a suitable error or explanatory message, or both, and returns to quiet state 502. In one embodiment, a CD will insist that PTT switch 450 be released and depressed again before attempting another floor-control request. If granted, a CD enters the group-services talk state 506, signals the user with a brief audible tone, and begins transmitting media traffic to CM 218 for as long as PTT switch 450 is keyed. At any time, CM 218 may signal CD 202 that it has lost control of the floor. Upon receipt of such a signal, CD 202 will abort transmitting media traffic and alert the user with an error tone until PTT switch 450 is released, at which point it returns to quiet state 502. Otherwise, once PTT switch 450 is released, CD 202 signals CM 218 that it has released the floor and returns to quiet state 502.

Detailed Description Text (73):
When any CD has the floor of a net, the net is said to be active; otherwise, it is inactive. If a net is inactive for a time exceeding a predetermined time period, called the net's hang-time, CM 218 may put the net in dormant mode 208 by individually signaling all registered CDs to release their over-the-air traffic channels as described by IS-707.5, or whatever over-the-air data service is being used. Enough state is maintained to allow a floor-control request or other traffic to bring the net out of dormant mode 508 relatively quickly. Net members may ignore the "go dormant" message. CM 218 does not explicitly or implicitly track the dormancy status of individual net members.

Detailed Description Text (74):
Typically, CM 218 will "wake-up" a net and bring it out of dormant mode 508 when a successful floor-control request is received during dormancy. As soon as the floor-control request has been granted, CM 218 will signal each registered CD by requesting an "are-you-there" (AYT) response over the media signaling channel and start an internal wake-up timer. In the preferred embodiment, each CD is required to acknowledge receipt of the AYT to CM 218 if it wishes to remain registered in the net. Optionally, a dormant CD 202 may buffer media traffic from the time the user keys PTT switch 450 until a traffic channel assigned to CD 202 is (re)connected. CM 218 may buffer media traffic received from the talking CD 202 until the wake-up timer exceeds a wake-up timeout, at which point, it will begin forwarding media traffic to each registered CD--including, in one embodiment, any members which have not yet responded to the AYT request. CM 218 may periodically retransmit AYT requests to any registered CD which has not acknowledged receipt of the AYT. Once the wake-up timer has exceeded a second, longer time period called the "late-riser" timeout, CM 218 will unregister any member CD whose AYT acknowledgement is outstanding and stop the wake-up timer. CM 218 ignores duplicate AYT responses.

Detailed Description Text (78):
CD 202 may be used to place a point-to-point voice services or secure point-to-point voice data calls at any time, whether group services are active or not, as long as CD 202 is not simultaneously acting as a talker. If CD 202 has registered as a member of a net, CD 202 should unregister from the net when placing a point-to-point call. If the selected point-to-point call will be placed via a voice service option, CD 202 will also terminate data services. Once the pointto-point call has been completed, CD 202 may transparently enable data services and re-register as a member of the current selected net.

Detailed Description Text (79):
CD 202 may be used to receive PSTN or secure point-to-point data voice calls while group-services is enabled, within the limitations imposed by the particular air-interface cellular infrastructure. If CD 202 joined a net, and the selected net is active, CD 202 will appear busy to an incoming PSTN call and the call will be given the appropriate busy treatment by the air-interface cellular infrastructure. If the selected net is quiet but the net's hang-time has not expired, the call will also be given the normal busy treatment by the airinterface cellular infrastructure. However, if the selected net's hang-time has expired, and the net has been placed in dormant mode, and CD 202 has released its over-the-air resources, the call may not be given busy treatment by the infrastructure and CD 202 may be paged to initiate receipt of the incoming call.

Detailed Description Text (84):
FIG. 6 illustrates a functional block diagram of CM 218. Further details of CM 218 may be found in copending U.S. patent application Ser. No. 09/518,622, entitled "METHOD AND APPARATUS FOR ENABLING GROUP COMMUNICATION SERVICES IN AN EXISTING COMMUNICATION SYSTEM", filed on Mar. 3, 2000, and is incorporated by reference herein. CM 218 supports at least three logical external interfaces, which, in the preferred embodiment, are all IP based, and which may all have multiple instances operating simultaneously. A SIP interface is provided by SIP user agent server 600. Real-time media signaling and control are supported by one or more media control units (MCU) 602. Administration functions are supported by a combination of CLI and HTTP servers, shown in FIG. 6 as administration interface 604.

Detailed Description Text (86):
No assumption is made as to whether CM 218 is implemented as a single physical entity, or several entities connected via a high-speed internal communication path. It may be deemed necessary, for example, to dedicate special-purpose hardware to handle the real-time media switching loads, or use a physically separate database engine to host local memory 606. Likewise, toplevel SIP redirect server 610 and global database 612 may be separated from the media or administrative functions and implemented as a separate entity.

Detailed Description Text (107):
The net database defines a set of nets known to CM 218. The net database also lists the defined members of each net--those users who may request to join and become participants in a net. Each record in net database comprises one or more fields for storing pertinent data corresponding to each net. In one embodiment, each record comprises at least a net identifier field, a net-address field, a net owners field, a net security field, an arbitration scheme field, a net vocoder field, a PTT fail-safe field, a hangtime time-out field, a PTX Dormancy Response timeout field, a wake-up timeout field, a late-riser timeout field, an AYT timeout field, a media channels field, and a net membership field. Additional fields may be added, or a number of fields may not be necessary, depending on the features and capabilities of a particular application. Each field is described as follows.

Detailed Description Text (108):
The net identifier field comprises a unique identification code, identifying particular nets within the context of CM 218. The net-address field comprises a SIP compatible net-address of the corresponding net. The net-owners field comprises a list of users, identified by user identifiers, who have administrative privileges for the correspoding net. The net security status field comprises an indication of whether the corresponding net is clear or secure. In an alternative embodiment, this field could identify various levels of security, such as none, classified, and secret. The arbitration scheme field comprises a unique value identifying an arbitration scheme used to resolve PTT arbitration conflicts between net participants. The net vocoder field comprises a value identifying a standard vocoder shown in the net's advertised session description. Net members incorporating such a vocoder in CD 202 will have this vocoder listed in their list of supported vocoders. The PTT fail-safe field comprises a maximum time that a net participant may transmit media to the net before CM 218 will revoke the talker privilege. The hang-time timeout field comprises a maximum time that the net may remain idle before CM 218 will place it in the dormant state. The PTX dormancy response timeout field comprises a maximum time that CM 218 will wait after determining that a dormant

net's talker privilege can be granted before transmitting a PTX message to a requesting CD. The wake-up timeout field comprises a maximum time that CM 218 will wait for net participants to respond to an AYT "wake-up" message before granting an outstanding PTT request. The late-riser timeout field comprises a maximum time that CM 218 will wait for a CD to respond to CM 218's AYT "wake-up" message before CM 218 will remove the non-responding CD from the net's list of active participants. The AYT timeout field 30 comprises a maximum time that CM 218 will wait for a CD to respond to an AYT "wake up" message before CM 218 will remove CD 202 from the net's list of active participants. The media channels list field comprises a list of media channels, including payload specifications, for the net. Each net will generally list at least one media channel which transports voice. Secure nets may list a second data channel. The net membership field comprises a list of defined members of the net and associated net specific privileges.

Detailed Description Text (112):
In one embodiment of the present invention, CM 218 includes a separate administration interface 604 through which CM 218 may be administrated and real-time status reports regarding CM operation obtained. Other variations are possible. The administration interface consists of two network ports, a TCP/IP based Hyper Text Transfer Protocol (HTTP) interface supporting administrative access through a conventional Java-capable web browser, and a TCP/IP based group communication specific Command Lime Interface (CLI).

Detailed Description Text (115):
The CLI is capable of supporting several administrative functions, such as creating a new user record in a user database, deleting an existing user record, and modifying an existing user record. Other functionality may include the ability to create new nets in the user database, deleting existing nets, and modifying existing nets. Still other functions may include the ability for an administrator to list all users by user name, dial number, user identifier, as well as other criteria, the ability to list all nets, by net-address and net identifier, in the Net Database, the ability for an administrator to show all fields for a specific user record, and the ability for the administrator to show all fields for a specific net identified by the net's net identifier or net address. The CLI may further include the ability for an administrator to query for a static status report for a specific net, or individual net member. This function may also allow the administrator to query for real-time (updated) reports, and, in particular, allow the administrator to identify the current list of net participants, the current talker, the presence or absence of media traffic, and identify any media signaling messages sent or received by CM 218.

Detailed Description Text (122):
Upon connecting to CM 218 for the purpose of net administration, the administrator will generally authenticate itself to insure only authorized administrative actions are accepted. Different levels of access are allowed; for example, authorized net members may connect directly to CM 218's administrative interface to modify specific net membership lists, but more generic administrative privileges are reserved for specific administrative accounts. For clarity, administrative actions are separated into those which deal specifically with user definitions and those which define nets. A user definition may include a username, unique CD cellular system identifier, CD phone number, and user e-mail address. CM 218 will also internally define a unique user identifier which may be passed to CD 202 and used to uniquely identify the user in signaling messages. A net definition may include a net-address, net hang-time, private dispatch timeout, and member list. A net's member list consists of a list of member records, which individually contain a user identifier and priority level. A member with the minimal level of priority generally has listen-only privileges.

Detailed Description Text (123):
CM administrators can monitor the current status of nets for which they have administrative privileges. In particular, administrators can determine the current list of net participants as well as monitor the net's state (active, inactive, dormant, in wake-up, etc.). Whenever the net is active, the administrator can also monitor the identity of the current talker. Additional statistics and status, such as the length of current session, total talk time of an individual user or a net,

the last time that a particular net member held the transmission privilege, mean number of registrants, etc., may also be available to administrators through the administrative interface.

Detailed Description Text (128):
Most group communication network traffic can be described as either signaling or media traffic. Signaling traffic can be further differentiated into two distinct categories: call setup and control signaling, which consists primarily of SIP invitation requests and acknowledgements, and media signaling, which is comprised primarily of real-time floor control requests and related asynchronous messages. Media traffic is comprised of real-time point-to-multipoint voice or data broadcasts.

Detailed Description Text (176):
Prior to attempting to join a net, CD 202 may place a call using the SIP INVITE method to request an updated list of available nets. For example, a CD denoted by a mobile identification number, or dial-number, MS6199726921 which has brought up an over-the-air connection using the IS 707.5 Packet Data Service option and has been assigned an IP address of 192.168.172.25, wishes to determine its current list of available nets by querying a top-level SIP server with a DNS address of sip.acme.com. As shown in FIG. 7 at time 1, CD 202 would open a UDP/IP connection to the SIP server port on sip.acme.com and issue a request similar to the following: INVITE sip-nets@nbs.acme.com SIP/2.0 Via SIP/2.0/UDP 192.168.172.25 From: sip:MS6199726921@nbs.acme.com To: sip:nets@nbs.acme.com Location: sip:192.168.172.25:5062 Call-ID: 123@192.168.172.25.acme.com Case: 1 INVITE Content-Length: 0

Detailed Description Text (179):
As shown in FIG. 7 at time 2, CM 218's top-level SIP server may redirect the request, using SIP redirection mechanisms, to a destination specifically defined to receive and respond to requests for net information. Upon receiving such a redirection, CD 202 will ACK the response at time 3, and re-send the INVITE request to the redirected destination, as shown at time 4. A sample SIP redirection response is given below: SIP/2.0 302 Moved temporarily From: sip:MS6199726921@nbs.acme.com To: sip:nets@nbs.acme.com Call-ID: 123@192.168.172.25.acme.com Contact: sip:nets@nbs.acme.com CSeq: 1 INVITE

Detailed Description Text (181):
Once the INVITE requesting a list of nets is successfully received and accepted by CM 218, CM 218 should deliver an INVITE request response at time 5, similar to the following: SIP/2.0 200 OK From: sip:MS6199726921@nbs.acme.com To: sip:nets@nbs.acme.com Call-ID: 123@192.168.172.25.acme.com CSeq: 1 INVITE Content-Type: application/nbs Content-Length: 71 G bravo@nbs.acme.com S 2 audio data G dc@nbs.acme.com C 1 audio G techapps@nbs.acme.com C 1 audio

Detailed Description Text (189):
CD 202 requests to join a net by issuing a SIP INVITE request to the net's managing CM, shown in FIG. 7 at time 7. If CD 202 does not have an open UDP/IP connection to the SIP server, it will open a new UDP/IP connection to the SIP server port.

Detailed Description Text (192):
The INVITE request may include a description of the media sources which will originate with CD 202, assuming the invitation succeeds. If included, the description may be included as message content and described using standard SIP Content-Type and Content-Length field constructions.

Detailed Description Text (193):
In the example above, CD 202 is advertising it will source a single audio session formatted using the RTP/AVP PureVoice payload profile. The session description is delivered in a format compatible with the Session Description Protocol (SDP) defined by RFC 2327. After defining the SDP version (v), the session description includes a mandatory origin (o) description; in the example, a random session identifier, 3115132610 and session version, 3201, are chosen such that the combination of the session identifier, version, and network and address type, IN IP4, and address, 192.168.172.25, forms a globally unique identifier for the session. CD 202 may use

any convenient mechanism for choosing the values for the session identifier and session version. Providing an estimate of the current time is one possible way of defining the session identifier.

Detailed Description Text (194):
Connection data (c) is specified by defining the network type, IN; address type, IP4; and connection address, 192.168.172.25. CD 202 uses the IP address with which it will label (or source) media traffic as the connection address. CD 202 uses the name portion of the net's net-address as the session name (s), in this case, acme.

Detailed Description Text (195):
CD 202 specifies the lifetime (t) of the session by providing its best estimate of the start or current time, 311532610, in Network Time Protocol (NTP) format, and indicates that the session is unbounded, 0.

Detailed Description Text (196):
The media format (m) description defines the media type, audio; source port, 5200; transport protocol, RTP/AVP; and payload format, 12, which CD 202 intends to use to transmit to the net. The RTP/AVP payload profile maps a payload type of 12 to represent audio encoded using the PureVoice vocoder, developed by the assignee of the present invention.

Detailed Description Text (198):
To indicate a successful invitation, and specifically inform CD 202 that it has been added to the list of participants for the invited net, CM 218 delivers an INVITE response at time 8 similar to the following: SIP/2.0 200 OK Via SIP/2.6/UDP 192.168.172.25 From: To: acme Call-ID: 421b2-314159@192.168.172.25.qualcomm.com CSeq: 1 INVITE Content-Type: application/sdp Content-Length: 179 v=0 o=-3115132612 74512 IN IP4 192.168.156.18 s=acme a=type:nbs c=IN IP4 192.168.156.18 m=audio 8422 RTP/AVP 12 m=control 8420 UDP/NBS

Detailed Description Text (208):
After receiving a successful INVITE response, CD 202 confirms the invitation by sending a SIP ACK request back to the net's MCU's SIP user-agent server, shown in FIG. 7 as time 9. After the sample exchange shown in FIG. 7, an ACK request similar to the following would be transmitted: ACK sip:nbs.qualcomm.com;transport=tcp SIP/2.0 Via SIP/2.0/TCP 192.168.172.25 From: To: condor Call-ID: 421b2-314159@192.168.172.25.qualcomm.com CSeq: 1 ACK

Detailed Description Text (211):
At any time after CD 202 has transmitted a SIP ACK message in response to a successful INVITE response, CD 202 may formally terminate its participation in the net by sending a SIP BYE message to the net's SIP useragent server, shown in FIG. 7 as time 10. Prior to sending the BYE, CD 202 may need to open a TCP connection to CM 218.

Detailed Description Text (214):
The BYE is acknowledged by CM 218 with a BYE response, shown in FIG. 7 as time 11, and similar to: SIP/2.0 200 OK Via SIP/2.0/TCP nbs.qualcomm.com From: To: condor Call-ID: 421b2-314159@192.168.172.25.qualcomm.com CSeq: 2 BYE

Detailed Description Text (222):
After CD 202 has successfully negotiated entry into the current membership of a net using SIP, real-time call control takes place through point-to-point application level media signaling messages exchanged between each CD and the net's MCU. The following group communication media signaling message types are defined.

Detailed Description Text (224):
A push-to-talk (PTT) request message is sent by CD 202 to CM 218 and signals a user's desire to broadcast media, typically voice, to the net. Normally, a PTT request message is sent each time PTT switch 450 is activated on CD 202. In addition, a PTT release message is sent by CD 202 to CM 218 to denote a release of PTT switch 450.

Detailed Description Text (225):

The PTT message comprises a number of fields containing various information used to grant or release the transmission privilege. In one embodiment, a first field is used to designate whether the PTT message is a request for the talker privilege or a release of the talker privilege. A second field is used to identify which CD has sent the PTT message. A third field is used to provide a unique message identifier to allow subsequent PTT release and PTX messages (defined later) to reference a specific PTT request. The identifier should be unique within the registration session of a particular CD. In one embodiment, CD 202 expects to receive at least one PTX response message for every transmitted PTT request. If a PTX response is not received within a predetermined time, CD 202 assumes the PTT was lost in transit and retransmits a second PTT message using the same PTT message identifier in the third field. The predetermined time can be for a fixed time duration or it can be altered dynamically, depending on system conditions. For example, the predetermined time could have a relatively short duration (one to two seconds) if the net is not dormant. In this case, CM 218 should be able to respond relatively quickly to the PTT message. If the net has entered dormant mode, the timeout should be extended to accommodate the additional time required to return the active state.

Detailed Description Text (228):
A PTX message is sent by CM 218 to a first CD 202 to acknowledge and respond to a previous PTT request from the first CD 202, as well as to signal various arbitration events. CM 218 uses the PTX message to respond to a PTT message, including both requests and releases. The PTX message includes information as to whether the referenced PTT request message was granted or denied. When responding to a PTT release message, the PTX message is used to indicate confirmation of receipt. CM 218 may also use the PTX message to deny a previously granted PTT request message (if a higher priority CD issues a PTT request message, the transmission privilege expires (i.e. times out), or some other event occurs requiring that the transmission privilege be revoked).

Detailed Description Text (229):
In one embodiment, the PTX message comprises several fields used to convey information to a PTT message. A first field is defined which indicates whether the PTX message is a synchronous response to an outstanding PTT request, or if it is an asynchronous message indicating an error or priority arbitration conflict. A second field references a previously received PTU request. A third field indicates whether the PTX message is granting, denying, revoking, or confirming the transmission privilege. A fourth field provides additional information explaining the PTX action, particular in cases when the PTX message denies, revokes, or cannot act upon a prior PTT request. This field may indicate that a higher priority talker has been granted the transmission privilege, or that CD 202 is not listed as a net participant and hence is not allowed to submit media signaling requests for the net. A fifth field represents the maximum time duration for which the transmission privilege is valid. CM 218 starts a timer from when the PTX message is transmitted. In another embodiment, the timer is initiated when CD 202 begins sending media traffic. The value of this field may be a fixed parameter, or it may be variable, depending on various parameters, such as the amount of net traffic, the number of active net users, etc.

Detailed Description Text (232):
A PTA message is sent by CM 218 to each CD currently participating in a net to announce the identity of the source of pending media traffic. A PTA message is also used to formally announce a release of the transmission privilege. The PTA message comprises a field that indicates whether the PTA message is announcing the granting (or denying) of the transmission privilege. In addition, other indications are possible within this field, such as revoking or confirming the transmission privilege. A second field identifies the particular CD 202 which will source media traffic to the net until the next PTA message is sent.

Detailed Description Text (234):
In one embodiment, PTA announcement messages are not acknowledged. Lost PTA messages are not detected nor retransmitted. A CD which does not receive a PTA announcement may be unable to display the talker identity of the subsequent talker. However, in another embodiment using RTP encapsulated media includes a source destination field which uniquely identifies the sender. A CD may cache the mapping between prior PTA

announcements and media streams and make use of this information to identify RTP encapsulated media streams using the source destination field if a corresponding PTA announcement message for a particular talk period is not received.

Detailed Description Text (237):
An AYT may be sent to determine whether CD 202 is still able to be contacted via data protocols or if CM 218 desires to bring the net's associated cellular traffic channels out of dormant mode. An AYT message may comprises a unique message identifier to allow a subsequent IAH response message (defined below) to reference a specific AYT request message. The unique message identifier may include a timestamp reference for generating latency estimates. Note that AYT messages are not necessarily broadcast to each CD at the same time. CM 218 may stagger sending AYT messages to each net participant to avoid receiving a flood of simultaneous IAH message responses.

Detailed Description Text (241):
CM 218 assumes that CD 202 will acknowledge any received AYT messages with an IAH response message. If the referenced AYT message was sent to confirm that a CD remains connected in an quite state, i.e., passively monitoring net media traffic and signaling, CM 218 notes the time of the IAH receipt for future reference.

Detailed Description Text (243):
If CM 218 notices that no net activity in the net, or in another embodiment, with individual net members, has occurred for a predetermined time, it will send a "Sleep" message, or ZZZ message, to one or more CDs to encourage them to release an associated over-the-air resource and enter the dormant state. Each CD may choose to ignore this message, for instance when it is concurrently supporting other packet applications. In one embodiment, a sleep message comprises an identification code corresponding to the CM 218 sending the sleep message, for CDs to differentiate between multiple receipts of the sleep message.

Detailed Description Text (244):
In one embodiment, CD 202 does not acknowledge receipt of the sleep message and no error recovery is attempted if the sleep message is lost. To guard against a sleep message being lost, CM 218 may send multiple copies of the same sleep message to an individual CD or to an entire net. CM 218 will insure that all copies of the same sleep message are sent within a defined interval, and CD 202 should wait for a period longer than this interval from the time the first sleep message is received before releasing its over-the-air link and transitioning to the dormant state.

Detailed Description Text (250):
In one embodiment, CD 202 does not acknowledge receipt of FYI message responses. If a FYI message response is lost, CD 202 will send a new ASK message request after a predetermined time period has elapsed since sending the previous ASK message.

Detailed Description Text (253):
At time 1, an active CD 202 sending a PTT request to CM 218, indicating a user's desire to broadcast media to the net by issuing a PTT message request. In response to the PTT request, at time 2, CM 218 responds with a PTX message response to the requesting CD 202 which may either grant or deny the request. If the request is granted, a PTA announcement message is sent to the net participants at time 3. In addition, a second PTX message response may be sent later if the user, continues to broadcasts beyond the net's PTT timeout or if a higher priority user issues a PTT request while CD 202 is broadcasting.

Detailed Description Text (254):
CD 202 normally broadcasts media traffic until the user releases PTT switch 450, at which point it signals the end of the talk period by issuing a PTT release message to CM 218, shown in FIG. 9 at time 4. CM 218 responds with a PTX confirmation message at time 5 and broadcasts an announcement signifying the end of the talk period to the net participants at time 6.

Detailed Description Text (257):
CM 218 maintains a first timer, called the inactivity timer 614, for measuring a net's hang-time, defined as a time period in which no member of a net is

transmitting information to the other net members. When inactivity timer 614 reaches a configurable, predetermined value, it triggers CM 218 to place a net in a dormant state by broadcasting a sleep media signaling message to the net participants. In another embodiment, an individual inactivity timer 614 is maintained for each member of a net, and after a configurable, predetermined time period, the inactivity timer triggers CM 218 to place each member into the dormant state, one by one, by sending a sleep message to members as their individual inactivity timers expire.

Detailed Description Text (260):
Wake-Up Time

Detailed Description Text (263):
In one embodiment, when a net is transitioning out of the dormant state, CM 218 will refrain from sending an initial PTX message until a configurable second timer, called the PTX Dormancy response timer 616, expires. After this timer expires, CM 218 will send a PTX grant message as usual. However, CM 218 will refrain from forwarding media to the net until a third timer, called the net's wake-up timer 618, expires. Any media received from a transmitting CD during this time will be stored in a buffer 622 within CM 218. In one embodiment, both timers reset when CM 218 determines that the transmission privilege can be granted. In another embodiment, wake-up timer 618 is reset when the PTX grant is transmitted. In yet another embodiment, wake-up timer 618 is reset when media is received by CM 218 after the PTX grant has been transmitted. The value of wake-up timer 618 is generally greater than the value of PTX dormancy response timer 616. After wake-up timer 618 has expired, CM 218 begins forwarding media and media signaling from buffer 622, if any media has been received during the wake-up time period. Both timers are generally configurable on a per net basis.

Detailed Description Text (273):
If the PTX message response arrives denying the PTT request, CD 202 will signal the user that permission to talk to the net has been denied. At this time, any voice information stored in the internal media buffer may be erased.

Detailed Description Text (274):
If the talker privilege is granted, but the PTX message does not arrive before all available internal memory space is consumed, CD 202 may simulate a PTX denial and signal the user to stop talking. If CD 202 has not been able to reestablish service, it may also need to take other error action at this point and inform the user accordingly. Alternatively, if by this time, a data services connection has been re-established, CD 202 may, in this situation, begin transmitting voice media to CM 218 without prior receipt of a PTX message.

Detailed Description Text (276):
During the transmission of any buffered media from buffer 622, CM 218 will treat the net as active, even if the talking CD has released the talker privilege. Hence, CM 218 will generally not allow a CD to interrupt the transmission of buffered media unless the interrupting CD has higher priority than the source of the buffered media.

Detailed Description Text (277):
The size of the internal media buffer in CD 202 may be chosen based on the maximum time expected to transition to the connected state from the idle state. Similarly, the size of buffer 622 in CM 218 should be chosen based on the (maximum) value of the net's wake-up timer specified in CM 218's net database.

Detailed Description Text (282):
Under normal circumstances, a CD which has negotiated itself into the dormant state can expect a base station to maintain the state associated with the dormant data call for up to 24 hours before it will drop the call. However, when base station resources are at a premium, some base stations are permitted to drop the call after only 10 minutes of dormancy--and to do so without explicitly notifying CD 202. Such behavior by the base station can directly result in the user unknowingly missing significant or important portions of a net's media traffic, as CD 202 will remain in dormant mode until it (or the user) takes action, such as keying PTT switch 450. Hence, in such situations, CD 202 will only discover that the data call was dropped

after it attempts to bring the call out of dormancy. As a result, CD 202 cannot assume that a base station will reconnect a data call in the dormant state when net activity resumes if the data call has been dormant for more than the maximum allowed dormancy time, in the present example, 10 minutes.

Detailed Description Text (284):
Performing this check allows CD 202 to insure that it can detect when and if a dormant data call is dropped by the base station within a reasonable time of the drop occurring. Because the base station will generally not drop a data call which has been dormant for a period of less than 10 minutes, CD 202 will generally not perform this check until at least 10 minutes has expired since CD 202 last transitioned to the dormant state. The time for sending such a check may be a fixed, predetermined value, or it may be configured by a user through the user-interface.

Detailed Description Text (287):
After the net has been idle long enough for the net's configurable hang-time to expire, CM 218 broadcasts a sleep request message to the net's participants, as shown in step 1. In response, each CD may release its over-the-air resources and enter the dormant mode, by releasing its air interface resources. Generally, this means that MSC 118 and base station(s) 216 discontinue the communication channel associated with a dormant CD, while maintaining various settings to allow a relatively quick re-connection to the communication channel. Note that, in one embodiment, the net participants do not respond to the sleep request message.

Detailed Description Text (288):
A successful PTT request by an CD will bring the net out of dormant mode, shown in FIG. 9 as time 2. (It should be understood that other events may bring a net out of dormancy. For example, a net administrator may need to contact one or more net members by sending a message to CM 218 for transmission to the one or more intended net members. CM 218 may provide an independent method of bringing a net out of dormancy. For example, if no PTT requests are received after a significant time period has elapsed, CM 218 may autonomously send an AYT message to the net participants to see which CDs are still responding to messages. Other possibilities of bringing a net out of dormancy are also possible.)

Detailed Description Text (289):
Prior to granting the PTT request with a PTX message at time 5, CM 218 will send an AYT message request to the other members of the requesting CD's net (time 3), forcing each previously participating CD out of dormancy if over-the-air resources were released in response to the sleep message, and to confirm that the CDs are-still able to be contacted via data protocols. At time 5, after a configurable time period, defined herein as the PTX dormancy response time, CM 218 transmits a PTX message, granting the transmission privilege to the requesting CD. The PTX dormancy response time gives CDs an opportunity to re-establish a communication channel and send an IAH message (time 4), alerting CM 218 that they are still able to be contacted. This allows CDs to receive communications from the PTT requestor once the PTX grant has been issued.

Detailed Description Text (290):
Once the PTX grant has been received by the requesting CD, it may begin transmitting media to CM 218. CM 218 may refrain from forwarding media to the other net members until a wake-up timer 618 expires. This is done by CM 218 storing the media in a buffer 622 within CM 218, or in an internal media buffer inside CD 202. The value of the wake-up timer is generally greater than the value of the PTX dormancy response timer. After wake-up timer 618 has expired, CM 218 begins forwarding media and media signaling from the buffer 622, or the internal media buffer, if information has been stored during the wake-up time period. If no information was transmitted during this time, any media received from the CD holding the transmission privilege is forwarded directly to the other net members.

Detailed Description Text (291):
Ideally, the PTX dormancy response timer is set to zero, so that a quick reply can be made in response to the PTT request. The wake-up timer allows CDs time to re-establish a communication channel while the PTT requester is transmitting media to CM 218. After the wake-up timer expires, CM 218 announces the talker by issuing a

PTA message at time 6 to the net participants and any media 'stored within the buffer may be forwarded to the other net members. If no buffering has taken place prior to the expiration of the wake-up timer, media is forwarding to the other net members as it is received by CM 218 from the talker.

Detailed Description Text (292):
Note that CM 218 may receive IAH message responses for an extended interval after the net is brought out of dormant mode and that CM 218 may not wait for all net participants to respond before granting the pending PTT request. Late responders whose IAH response arrives after the PTX message response is transmitted will remain listed as net participants, but may not receive all initial media traffic and signaling. Any CD which does not respond to the AYT request after a configurable time period is assumed to no longer be reachable and are removed from the net's list of active participants.

Detailed Description Text (295):
At time 1, a lower priority CD submits a PTT message request to CM 218 which is granted by CM 218 at time 2. CM 218 announces that CD 202 has the talker privilege by issuing a PTA message to net members at time 3.

Detailed Description Text (296):
While the-lower priority CD is transmitting media, a second CD attempts to interrupt by sending CM 218 a PTT message request at time 4 for the same net. CM 218 determines that the second CD has higher priority than the talking CD and consequently revokes the talker privilege from the talking CD by sending it a PTX revocation message at time 5. CM 218 then grants the PTT request to the higher priority CD with a normal PTX message response at time 6 and announces that the higher priority CD has the talker privilege by sending a PTA message to net members at time 7.

Detailed Description Text (329):
Generally, the user may enable or disable the encryption of net traffic at any time.

Detailed Description Text (337):
The key for an encrypted net is generally a random, binary number. In general, this key will be generated by one party in a net, or an administrator for that net, and distributed securely to the net participants. Since the key distribution policy is currently left to the net users and is external to CM 218, it is a potential source of compromise of the net security. A preferred method of key distribution is via secure means, such as via PGP encrypted e-mail to the net participants. Other methods are also possible--by telephone call or face to face meeting, or by automatic distribution, making use of a PGP secret key which is generally imbedded in each CD for SIP authentication.

Detailed Description Text (341):
The State Vector (SV) organization is shown in FIG. 12. In one embodiment, the state vector consists of the following fields: 16 Bit Sender ID field 1200: This field is used to help insure uniqueness of the crypto SV among users. For group communication service, the Sender ID should be a unique number for all users of a particular TEK (e.g. unique for an encrypted net). The sender ID will be chosen randomly by CD 202 when a key is entered into the phone for a particular net. Alternatively, users may have the option of entering a known unique random value. The sender ID is generally net specific, and does not change as long as the TEK is used. 4 Bit Application ID field 1202: This field is used to identify a crypto-stream used for different and possibly simultaneous applications such as voice, data, or in-call signaling. 44 Bit State Counter field 1204: This field is subdivided into the following subfields: 2 Bit Implicit Component 1206: This field is normally never sent (hence it is "implicit"), but is used to maintain SV uniqueness whenever multiple codebooks are needed to encrypt (or decrypt) a data frame. This counter can be thought of as a data frame codebook counter, reset to zero on each new data frame, counting the codebooks used per data frame. 14 Bit Short Term Component 1208: This field is sent periodically (within an RTP payload) and serves as a data frame counter. For group communication service, the entire field is sent once for each transmitted packet (which may include one or more data frames). This field can be thought of as a data

frame counter, since it increments by one for each data frame, regardless of the number codebooks needed per data frame. 28 Bit Long Term Component 1210: This field constitutes the "high order" bits of a 42 bit counter formed by the Long Term and Short Term components. During a transmission, this field automatically increments by one whenever the short term component "rolls over." The initial value of the long-term component is chosen randomly when a new key is entered. The long-term component is incremented every time the short term component rolls over. The long term component rolls over to all zeros if it reaches the all one's state.

Detailed Description Text (343):
There is no requirement for initialization of the lower 44 bits of the State Vector (other than the two bit implicit field, which is reset to zero for each data frame). The transmitter, however, is required to insure uniqueness of the State Vector (SV) over the life of the traffic key. The life of a traffic key may be an arbitrary (but finite) time. Sender ID field 1200 helps ensure that SVs are unique among a group of net users. The Implicit bits are initialized to `00` and are used in sequential order as a codebook counter within a data frame. This capability is applicable for data frames that are longer than a single codebook.

Detailed Description Text (354):
Successive RTP Payloads update the Short Term Component and Application ID on a per payload basis, while the remaining fields (including the Long Term Component) are sent six bits at a time, on a cyclic basis, to facilitate "late entry," as required for group communications. Since there are 44 bits to be sent periodically (28 Long Term+16 Sender ID), it will take 44/6 or eight packets to accumulate these components from the periodic transmissions. In addition, a predefined signal, such as two transmissions of all ones (111111) should be included between each cycle of the periodic transmissions (eight packets of periodic transmission+two flag) as a start of frame flag. The value of the Long Term Component transmitted in a sequence of eight frames is the value that was valid at the first flag frame at the beginning of the transmission (this covers the case when the Long Term Component is in the process of rolling over).

CLAIMS:

1. A system for providing a group communication service to a plurality of communication devices, comprising: a first communication device for converting information signals into data packets suitable for transmission over a data network, for providing said data packets to said data network, and for receiving data packets from said data network; a second communication device for converting information signals into data packets suitable for transmission over said data network, for providing said data packets to said data network, and for receiving data packets from said data network; a third communication device for converting information signals into data packets suitable for transmission over said data network, for providing said data packets to said data network, and for receiving data packets from said data network; and a communications manager connected to said data network for providing arbitrated group communications among at least said first communication device, said second communication device, and said third communication device, wherein said communications manager further comprises: a first timer for measuring an elapsed time in which said first communication device, said second communication device, and said third communication device have not transmitted data packets to said communications manager; and a processor for sending a message to said first communication device, to said second communication device, and to said third communication device to enter a dormant mode of operation if said elapsed time exceeds a predetermined time period.

2. The system of claim 1 wherein said communications manager further comprises; a second timer for measuring the elapsed time from when a transmission privilege request is received by said communications manager while said first communication device, said second communication device, and said third communication device is in said dormant mode; and said processor is further for sending a response to said transmission privilege request only after said second timer exceeds a predetermined time period.

3. The system of claim 2, wherein said communications manager further comprises: a

third timer for measuring the elapsed time from when said transmission privilege request is able to be granted by said communications manager; and a buffer for storing said information signals received from said first communication device until said third timer exceeds a predetermined time period.

8. A method for providing a group communication service to a plurality of communication devices, comprising: converting information signals into data packets suitable for transmission over a data network via a first communication device; converting information signals into data packets suitable for transmission over the data network via a second communication device; converting information signals into data packets suitable for transmission over the data network via a third communication device; providing arbitrated group communications among at least said first communication device, said second communication device, and said third communication device; measuring an elapsed time in which said first communication device, said second communication device, and said third communication device have not transmitted data packets; and sending a message to said first communication device, to said second communication device, and to said third communication device to enter a dormant mode of operation if said elapsed time exceeds a predetermined time period.

9. A computer-readable medium embodying a method for providing a group communication service to a plurality of communication devices, the method comprising: converting information signals into data packets suitable for transmission over a data network via a first communication device; converting information signals into data packets suitable for transmission over the data network via a second communication device; converting information signals into data packets suitable for transmission over the data network via a third communication device; providing arbitrated group communications among at least said first communication device, said second communication device, and said third communication device; measuring an elapsed time in which said first communication device, said second communication device, and said third communication device have not transmitted data packets; and sending a message to said first communication device, to said second communication device, and to said third communication device to enter a dormant mode of operation if said elapsed time exceeds a predetermined time period.

10. An apparatus for providing a group communication service to a plurality of communication devices, comprising: means for converting information signals into data packets suitable for transmission over a data network via a first communication device; means for converting information signals into data packets suitable for transmission over the data network via a second communication device; means for converting information signals into data packets suitable for transmission over the data network via a third communication device; means for providing arbitrated group communications among at least said first communication device, said second communication device, and said third communication device; means for measuring an elapsed time in which said first communication device, said second communication device, and said third communication device have not transmitted data packets; and means for sending a message to said first communication device, to said second communication device, and to said third communication device to enter a dormant mode of operation if said elapsed time exceeds a predetermined time period.

11. An apparatus for providing a group communication service to a plurality of communication devices, comprising: a memory unit; a receiver; a transmitter; and a processor communicatively coupled to said memory unit, said receiver, said transmitter, and said processor, said processor being capable of: converting information signals into data packets suitable for transmission over a data network via a first communication device; converting information signals into data packets suitable for transmission over the data network via a second communication device; converting information signals into data packets suitable for transmission over the data network via a third communication device; providing arbitrated group communications among at least said first communication device, said second communication device, and said third communication device; measuring an elapsed time in which said first communication device, said second communication device, and said third communication device have not transmitted data packets; and sending a message to said first communication device, to said second communication device, and to said third communication device to enter a dormant mode of operation if said elapsed time